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Research Briefs

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Nutrition and Health

Another study shows that the semisolid, hydrogenated fats found in stick margarine are less friendly to the heart than the oils they come from. When a group of men and women with moderately high cholesterol switched from a typical U.S. diet to a cholesterol-lowering diet, their "bad" LDL cholesterol dropped an average 17 percent. And the protein associated with LDL—which some believe is a better measure than the cholesterol value itself—dropped 20 percent. But these values dropped only 10 percent each when researchers substituted the corn oil in the diet with corn oil margarine in stick form. The oil also resulted in a more favorable ratio of total cholesterol to HDL cholesterol—the kind that protects our arteries from damage—than did the stick margarine. Substituting stick margarine for corn oil increased the amount of saturated fat in the diet more than 20 percent and resulted in a 10-fold increase in trans fatty acids. Hydrogenated vegetable oils are found in crackers, cookies and many other products, including fried fast food. In addition to being semisolid, they are less prone to oxidation. But the findings of this and earlier studies by ARS and other groups should discourage their use in cholesterol-lowering diets.

Human Nutrition Research Center on Aging at Tufts Boston, MA

Alice Lichtenstein, (617) 556-3127

High blood levels of the amino acid homocysteine—now recognized as an independent risk factor for cardiovascular disease—may also contribute to the loss of brain function in older people. That's the implication of a preliminary study of depressed patients by researchers at ARS's Boston center and a psychiatrist at nearby McLean Hospital. They wanted to know if high homocysteine levels are related to the loss of memory and the ability to learn that accompanies depression in the elderly. Homocysteine has the potential to damage the brain by two routes. First, depressed people have even more of the well-established risk factors for cardiovascular disease than older people in general. Excess homocysteine would further damage blood vessels in the brain. Second, homocysteine is converted to an amino acid that stimulates brain cell receptors at normal levels but can cause the cells to self destruct at excess levels. Blood analyses of 27 depressed elderly patients showed that they had significantly higher plasma homocysteine levels and lower cognitive test scores—indicating a loss of brain function—than did 15 young depressed patients. Homocysteine was highest in the older patients with vascular disease. In those free of vascular disease, however, homocysteine levels were highest in the patients who scored lowest on cognitive tests. Metabolism of the amino acid depends on the B vitamins—folic acid, B₆ and B₁₂. And treatment with these vitamins helps normalize blood levels. However further studies are needed to establish that high homocysteine is a cause rather than an effect of certain forms of dementia in the elderly before any treatment could be considered.

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The anti-cancer value of beta carotene and other carotenoids will be easier to assess with a new database developed by ARS and National Cancer Institute scientists. Now available from NCI, it gives levels of the five most common carotenoids in 150 fruits and vegetables and more than 2,000 mixed foods containing fruits or vegetables. Carotenoids are a group of nearly 600 yellow, orange and red pigments that give foods like carrots, peaches, squash and tomatoes their distinctive colors. But green leafy vegetables also have lots of the compounds, which are masked by the green color of chlorophyll. Researchers with ARS and NCI used these levels and the USDA survey recipes to determine the main contributors of the common carotenoids in the diets of women aged 19 to 50. Carrots, canteloupe and broccoli supplied the most beta carotene, while carrots were the chief source of alpha carotene. Spinach, greens (collard, mustard and turnip), and broccoli supplied the most lutein. And tomatoes and tomato products headed the list for lycopene. Oranges, tangerines and peaches were the top sources of beta-cryptoxanthin.

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Diets high in the sugar fructose significantly increased cholesterol levels—specifically the “bad” LDL cholesterol—in a group of five men. The men also tended to have higher blood glucose levels while consuming nearly twice the level of fructose found in the average diet. They were involved in a study to see if excess dietary fructose would aggravate the signs of copper deficiency in people as it does in test animals. Copper is an integral part of several enzymes that act to defuse oxygen free radicals in the body, and fructose metabolism is known to generate free radicals. So the men alternated between diets low and adequate in copper containing either 20 percent fructose or an equivalent amount of starch for seven weeks each. The combination of low copper and excess fructose decreased some of the body’s defenses against free radicals. But excess fructose alone increased serum cholesterol, regardless of the copper content of the diets. If the findings repeat in larger studies, it raises questions about the growing consumption of sugar (which is half fructose) and high-fructose corn syrups regularly added to processed foods and soft drinks.

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Tomorrow’s physicians could use a simple blood test with an ARS-developed equation to predict whether their dieting patients are likely to be fast or slow at losing fat. Before that happens, however, the equation needs to be

tested on more dieters, including overweight men and obese individuals of both sexes. When ready, the equation could help dieters set realistic goals, and assist health care professionals to better tailor each patient’s weight-loss plan. Researchers produced the equation by investigating a dozen biochemical factors during a three-month weight-loss study with 10 moderately overweight women volunteers. The equation is linked to one easy-to-measure indicator in the blood sample: the amount of fatty acids that circulate in the blood while dieters burn up stored fat during exercise. Generally, the higher this amount, the more rapid the dieter’s weight loss.

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Rescue personnel can be better prepared to help victims of Africanized honey bee attacks, thanks to ARS research. A bee researcher found that several fire-fighting chemicals normally carried on fire trucks, or even ordinary liquid dishwashing detergent, halt bee attacks immediately and kill bees in 60 seconds or less. The researcher has supplied the information, plus tips on how to avoid confrontations with the highly defensive bees, to journals and magazines for rescue personnel.

*Carl Hayden Bee Research Center, Tucson, AZ
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More evidence that dietary copper helps protect body tissues from oxidation comes from a study of rats’ lungs. Researchers with ARS and the University of North Dakota compared the effects of eating a copper-deficient diet with breathing pressurized air having close to four times the normal oxygen content. Such high-oxygen, high-pressure chambers apply oxidative stress to lung tissues, allowing researchers to simulate the effects of long-term exposure to ozone and other atmospheric oxidants. The results: Rats fed a copper-deficient diet for five to six weeks suffered about the same damage to their respiratory membranes as the group that spent an hour in the chamber. The animals that got both a copper-deficient diet and the high-oxygen suffered major damage. Under the electron microscope, their respiratory membranes were literally falling apart. People, like animals, use several copper-containing enzymes to deactivate the oxygen-containing compounds that cause damage. The findings suggest that U.S. diets—the majority of which contain less than adequate copper—may not be providing optimum protection against atmospheric oxidants. Adding oysters, liver, whole wheat, nuts and sunflower seeds to your diet will raise copper content.

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Women who find themselves eating more after they ovulate may be replacing extra calories they burn to maintain basal metabolism. That's what a study of energy expenditure during the three phases of the menstrual cycle suggests. While sleeping, 12 women volunteers burned five to seven percent more calories between ovulation and menstruation than they did during and after menstruation. Such differences indicate the menstrual cycle is a significant contributor to variations in women's basal metabolism, and possibly how many calories they eat. As a result, researchers conducting energy expenditure studies in women will need to either measure all women at the same points in their respective cycles or account for differences in basal metabolism.

*Beltsville Human Nutrition Research Center
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Itchy rashes and other allergic reactions to rubber products could be prevented by using allergen-free rubber from a desert shrub, guayule. Lab tests revealed that guayule rubber—extracted from the plant's stems and bark—is free of allergy-causing proteins found in many of today's natural rubber products such as gloves and condoms. In contrast, proteins in latex from the world's primary source of natural rubber, the tropical *Hevea brasiliensis* rubber tree, can cause allergic reactions ranging from prickly rashes to, in rare cases, life-threatening shock. Following lab experiments, the ARS scientists collaborated with medical researchers who tested more than 60 volunteers allergic to *Hevea* latex. When they were given a standard allergy test using a tiny amount of guayule rubber, none had an allergic response. If further tests confirm the preliminary findings, guayule could attract new interest as a high-value specialty crop for U.S. farmers in the southwest.
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Tomorrow's Foods

Genetically engineering disease resistance into animals has taken one small step forward. A mouse gene that produces an antibody against *Escherichia coli*, a common bacterium, was successfully inserted into mice, pigs and sheep. High levels of the antibody were detected in the serum of the mice and pigs, and the antibody was detected in one type of white blood cell in one of the sheep. Because this is only one of many antibodies to *E. coli*, it is not enough to provide immunity for the animal. But it illustrates that immunity can be "programmed" into the genes of animals.

*Gene Mapping and Evaluation Lab, Beltsville, MD
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High-quality vegetable seeds might sprout even after 100 years of storage in the cold, dry conditions of ARS' National Seed Storage Laboratory, scientists now believe. Seeds and other plant tissue hold genetic material used to develop hardier, higher-yielding, more nutritious crop varieties for farmers and consumers. But scientists need data on storage life so they can determine when a given seed batch is likely to begin deteriorating. Before that happens, the seeds can be planted to obtain fresh supplies for the lab's valuable archives of plant germplasm. Most vegetable seeds had been thought to survive only 30 years or less. But recent ARS studies showed muskmelon, pea, okra and tomato seeds may live more than 100 years, and seeds of 15 other vegetable species can survive 50 to 60 years.

*National Seed Storage Laboratory, Fort Collins, CO
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Mixtures of cornstarch and natural gums have many of the properties required for food thickeners and fat substitutes, ARS researchers found. So they will work under a cooperative agreement with Continental Colloids, Inc., of West Chicago, IL, to explore commercial development of food additives made from cornstarch and naturally occurring gums, such as guar, which is isolated from the guar plant. A mixture of about 95 percent cornstarch and gum will be tried as a thickener in dairy products. Natural gums, such as xanthin and guar gums, already are being used as thickeners in food products such as puddings, pie fillings and salad dressings.

*Plant Polymer Research, Peoria, IL
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A special genetic "insulator" tested in mice could help scientists ensure that new genes inserted in farm animals turn on and off at the proper time. Currently, these new genes sometimes don't function when desired, and this is hampering efforts to genetically improve cattle, sheep and pigs for disease resistance, leaner meat and other traits. ARS molecular biologists showed that a newly inserted gene can benefit from a genetic insulator, known as a matrix attachment site. The insulators are points on a chromosome that serve as a boundary, separating an individual gene from its neighbors, so the gene is less likely to turn on—or off—just because its neighbors do. To test this approach, scientists inserted a milk protein gene along with its insulators into laboratory mice. With the insulator sites, the gene's behavior was almost identical to the naturally occurring gene. But without the insulators, the gene turned on and off erratically.

*Reproduction Laboratory, Beltsville, MD
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Rice breeders can now get five new ARS breeding lines of rice with more of an essential amino acid, lysine. The extra lysine, about 15 percent more than in a typical variety,

makes rice a more nutritionally balanced protein. This would especially help people in developing countries where rice is the main—sometimes nearly the only—protein source. Current rice varieties grown in the world are low in lysine, but high-lysine ones bred from the new lines could be available in a few years. Scientists used a method called inhibitor selection to identify rice cells with a natural genetic mutation that kept them making lysine longer than other cells. Then they regenerated and field tested whole plants from the high-lysine cells. About 95 percent of rice is consumed in the countries where it's grown. But the United States exported more than 40 percent of its rice in 1991, accounting for one-sixth of global exports.
Plant Molecular Biology Lab, Beltsville, MD
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A simple blood test for calves may help beef producers put leaner meat on our tables. One way of obtaining lean beef animals is to use bulls produced by crossing traditional breeds with so-called “double-muscled” breeds that have larger muscles and very little fat. But not all bull calves from these unions inherit traits for lean meat. To identify those that do, researchers developed a blood test that measures levels of creatine, a protein produced by muscles. In all cases, calves that inherited the double-muscle, lean-meat traits had higher levels of creatine.
Meat Science Research Lab, Beltsville, MD
Morse B. Solomon, (301) 504-8400

Food Freshness and Safety

A cold-water jacuzzi containing a touch of vinegar could clean up the chicken-borne *Salmonella* problem, tests show. Engineers injected pressurized air into the first cold water bath on the chicken processing line—where a lot of the *Salmonella* cross-contamination occurs. Air scrubbing dramatically reduced the number of carcasses that came out of the bath with bacteria, but it made the birds' skin absorb more water than regulations allow. So the scientists added 0.6 percent acetic acid—which makes vinegar taste sour—to tighten the skin. In tests with chickens that had been artificially inoculated with *Salmonella*, the forced-air water bath cut contaminated carcasses by 90 percent compared to the plain water bath currently used. And the small amount of acetic acid reduced water retention to acceptable levels. The treatment leaves a slight yellow tint on the birds. The technology is now ready for full-scale testing by the poultry industry.
Poultry Processing and Meat Quality Research, Athens, GA
James A. Dickens, (706) 546-3205

Measuring the gases inside melons while they're ripening on the vine—a scientific first—will help assess new technologies for keeping fresh fruit tender and succulent. Scientists withdrew gas samples—carbon

dioxide, oxygen and the ripening hormone, ethylene—from the cavity of cantaloupe and honeydew. As expected, ethylene gradually increased as the melons ripened. But there was a surprise concerning CO₂. It has always been assumed that CO₂ rises sharply during ripening, but the scientists found no CO₂ buildup until after the melons were harvested. Monitoring cavity gases in vine-ripening melons is a new tool for assessing technologies such as gene alterations to make melons ripen on demand.
Crop Quality and Fruit Insects Research, Weslaco, TX
Krista C. Shellie, (210) 565-2647

A corn earworm female won't mate until she knows there are nearby plants her offspring can eat. And when she does mate, the male passes along not only sperm but a protein that stops her from luring other males—and may also cause her to lose interest in sex until she lays her eggs. Those first-of-a-kind findings could lead to environmentally friendly controls for the pest, which damages an estimated \$1.2 billion in crops each year. Scientists say the earworm female won't release a sex attractant until she senses plant chemicals that tell her food is available for her offspring. Once she mates, the male earworm transmits what's called a pheromonostatic peptide (PSP), which appears to prevent her from releasing any more sex attractant until she's released her eggs. Scientists have identified the sequence of 57 amino acids that make up the PSP protein. Next, they'll synthesize the protein in the lab and test it to confirm its action. The ultimate goal is to use a special insect-specific virus to transmit the male protein to corn earworm females to disrupt their mating.
Insect Neurobiology and Hormone Lab, Beltsville, MD
Ashok K. Raina, (301) 504-9396

Identifying the best yeasts for baking, brewing and other food uses is easier with an improved test keyed to yeast's genetic makeup—or DNA. The gene-based system could be ready for commercial use in five years. The system can pinpoint unwanted as well as helpful strains—crucial to foodmakers guarding against intruder yeasts in fermentation vats or mixing bowls. Unwanted yeasts, though not harmful, can change food flavor or texture or reduce yield in fermentation vats. The new system is the first to distinguish food yeasts by matching samples of DNA from entire chromosomes of yeast. That makes the technique more accurate than methods relying on DNA from bits and pieces of chromosomes. In addition, unlike some current yeast ID methods that require about 50 different tests, the new test, when ready, will be simpler to use.
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